Construction Methodology

INTRODUCTION

This appendix describes the procedures used to develop current estimates of value of construction put in place.

Value-in-place estimates are not published separately for individual series until data for the series are available. Therefore, publication of separate estimates is limited to quarterly data if the series is quarterly, and to annual data if the series is annual; however, projected or interpolated monthly estimates from these series are included in the monthly totals but are not shown separately.

PRIVATE RESIDENTIAL BUILDINGS

New single family

Construction cost of new single family houses started each month is estimated using housing starts and sales data from the U.S. Census Bureau's Survey of Construction (SOC) at
www.census.gov/const/www/newresconstindex.html (for starts) or
www.census.gov/const/www/newressalesindex.html (for sales).
The estimated cost of all single units started is then distributed into monthly value put in place by applying fixed patterns of monthly construction progress. The patterns are shown in the attached table.

Construction cost is estimated separately for units built to be sold or rented and units built by the owner or for the owner on contract. In both cases, the total cost is obtained by multiplying the number of units started by an average construction cost per unit. For units built to be sold or rented, the average construction cost is the average sales price at the time of start multiplied by the factor 0.8424. This factor eliminates an estimate of the cost of ''nonconstruction'' items such as raw land, marketing costs, closing costs, and movable appliances. The average construction cost for units built for the owner on contract is the average contract value at time of start increased by the factor 1.102 to eliminate ''nonconstruction'' items and add the value of land development not already accounted for.

Multi-family

A subsample of new residential building projects with two units or more is selected from the SOC. Once a project is selected, monthly construction progress reports are requested from the owner until the project is completed. About 2,500 projects are in the survey each month. This number includes newly selected projects, as well as projects carried over from the previous months. Estimates of value put in place are obtained by multiplying the final weight of each project by the reported value and summing all projects. The final weight can be expressed as follows:

Final weight = (basic weight) x (unit adjustment factor) x (adjustment factor for architectural, engineering, and miscellaneous costs).

a. Basic weight. The basic weight is the reciprocal of the probability of selection. Since the projects in the Multi-family Survey are a subsample of the SOC sample, the basic weight includes the reciprocal of the sampling rate used in SOC.

b. Unit adjustment factor. The unit adjustment factor is the ratio of the unbiased estimate obtained from the Census Bureau's Building Permits Survey of the number of Multi-family units authorized in a month to the unbiased estimate from the Multi-family Survey of the number of multi-family units authorized in a month.

c. Adjustment for architectural, engineering, and miscellaneous costs. The value put in place for the construction of a project includes the total construction cost and fees for architectural and engineering

services and miscellaneous costs. However, monthly reports from sample projects do not include architectural, engineering, and miscellaneous costs. Each month's reported value is inflated to account for these costs so that the sum of the values put in place each month is the total cost of the project. This adjustment factor is defined as the ratio of the total estimated value of the project reported by the owner (construction cost and architectural, engineering, and miscellaneous costs) to the estimated construction cost of the project reported by the owner.

Improvements

Data for this series are obtained by the Census Bureau from household interviews in a representative sample of owner-occupied units and a mail survey of owners of a sample of rental or vacant properties. Prior to 1985, these data were collected as part of the Census Bureau's Quarterly Household Survey of Residential Alterations and Repairs. Beginning with January 1984 statistics, estimates of expenditures on owner-occupied properties are based on data from the Consumer Expenditure Survey (CES) conducted by the Census Bureau for the Department of Labor's Bureau of Labor Statistics. A detailed description of this survey and the mail survey and a comparison of the old and new series for 1984 appear in Construction Reports, C50-85-Q1, *Residential Alterations and Repairs*, issued in October 1985. The CES was designed to provide the Bureau of Labor Statistics with a database for purposes relating to the Consumer Price Index. These estimates have high variances and are not shown separately in the tables of monthly estimates.

Data from owner-occupied units are collected through a rotating panel survey design. There are three panels: one panel is interviewed during the first month of a quarter, another panel during the second month and a third panel during the last month. Each panel reports on improvements done since the previous interview 3 months ago; thus, an expenditure may be reported in the month of interview, the month before, 2 months before or 3 months before, but after the previous interview. Data collection for expenditures in a month will not be completed until 3 months after the month and an estimate based on all of the data will not be available until approximately 5 months after the month.

Data from the mail survey of owners of a sample of rental or vacant properties are collected after the end of each month and accounts for about 20 percent of the estimate.

The estimates of total residential improvements are usually forecasted data at least 1 or 2 months in advance. The revised estimates are still based on incomplete data and in many cases are still forecasts. Estimates based on complete data are first used in the May publication for revisions to the previous year. The total improvements estimates are subject to substantial revisions from the preliminary estimates due to the necessity of forecasting. For estimates beginning in 1993, time series techniques with the X-12-ARIMA program have been used to remove the irregular effect.

PRIVATE NONRESIDENTIAL CONSTRUCTION

The Census Bureau conducts a monthly Construction Progress Reporting Survey for estimating the value of private nonresidential construction in the United States. This survey uses two sources of information for identifying nonresidential building projects:

1. Data from the F.W. Dodge Division of the McGraw-Hill Information Systems Company on projects valued at $75,000 or more in the United States.

2. Projects in a sample of areas not covered by building permit systems or reported by Dodge.

Projects from source 1 are stratified by type of construction and construction value. Sixty-six strata are created and each stratum is assigned a specific sampling rate. Of the 66 strata, 16 are certainty strata and have a sampling rate of 1-in-1. Within each of the remaining 50 noncertainty strata, a systematic

sample of projects is selected each month continuing from the sample selected from the previous month. Projects from source 2 (nonpermit areas) are selected with virtual certainty. Once a project is selected, monthly construction progress reports are requested from the owner until the project is completed. About 8,500 projects are in the survey at any one time.

Estimates of value put in place are obtained by multiplying the final weight of each project by the monthly reported value and summing all projects. The final weight can be expressed as the product of the following:

Final weight=(basic weight) x (outlier adjustment factor) x (adjustment factor for architectural, engineering, and miscellaneous costs)

a. **Basic weight**. The basic weight varies with each source and project.

1. For projects from sources 1 and 2, the basic weight is the reciprocal of the probability of selecting a project.

2. For projects from source 3, the basic weight is the reciprocal of the probability of selecting a nonpermit segment.

b. **Outlier adjustment factor**. This factor reduces the influence on the VIP of an extreme noncertainty observation that reports an extremely large total construction value.

c. **Adjustment factor for architectural, engineering, and miscellaneous costs**. This factor is computed in the same manner as in the Multi-family Survey (see above).

Imputations are made for projects that have not reported at the time of the monthly tabulation, based on estimated total construction value and month of start of the project. Weighted data are summed over all sample projects by type of construction. The results are increased by 25 percent to account for undercoverage of construction projects not reported by F.W. Dodge. The adjustment for undercoverage results from comparison studies, conducted by the Census Bureau, of Dodge reports with building permits for a sample of projects for which permits were issued.

The manufacturing category is further adjusted by benchmarking the tabulated estimates to the latest detailed structures data from the Census Bureau's Annual Capital Expenditures Survey (ACES). The 1992, 1994, 1998, and 2003 levels for industrial buildings are based upon actual ACES data. Estimates for other years are extrapolations from the 1992, 1994, 1998, and 2003 levels.

FARM CONSTRUCTION

Value-in-place estimates for new farm nonresidential construction are extrapolated from the annual U.S. Department of Agriculture (USDA) report, *Income and Balance Sheet Statistics*. Monthly or quarterly estimates are not available. To estimate monthly values, including projections for the current and following year, the USDA data are developed using the trend of private nonbuilding construction put-in-place estimates.

REGULATED INVESTOR-OWNED UTILITIES CONSTRUCTION

Value-in-place estimates for the telephone component of communication construction are based on reports of actual monthly construction progress. For the electric, gas, railroad, oil categories, and the TV cable component of communication, construction put-in-place estimates are based on annual capital expenditure reports compiled by federal regulatory agencies and private organizations.

Pending availability of annual data, monthly estimates for railroads are obtained by distributing Surface Transportation Board quarterly construction expenditures estimates into monthly values. Preliminary monthly estimates for TV cable, electric, and gas construction are based on annual forecasts from Paul

Kagan Associates, Inc., the Edison Electric Institute, and the American Gas Association; and oil estimates are projections from the latest final year of Federal Energy Regulatory Commission data. Expenditures made by nonregulated utilities are gathered in the same method as private nonresidential construction (see above). Monthly estimates are published only for communication and electric; however, estimates for other public utilities are included in the appropriate totals.

PUBLIC CONSTRUCTION

Public construction is composed of two parts: state and local construction and federal construction.

State and Local

The information for creating the sampling frame for the state and local survey is obtained from the same F.W. Dodge data used for private nonresidential construction (see above).

The projects are stratified by type of construction and value according to the information from Dodge. Seventy-two strata are created and a sampling rate is assigned to each stratum. Of the 72 strata, 15 are certainty strata. Within each of the remaining 57 noncertainty strata, a systematic sample of projects is selected each month continuing from the sample selected from the previous month. Once a project is selected it remains in the survey until completion of the project, and monthly construction progress reports are requested from the appropriate agency in charge of the project or its designated agent, such as the builder or architect responsible for the project. The average number of projects in the survey at any one time is about 8,500. These include newly selected projects, as well as projects carried over from previous months.

Tabulation of data is the same as for private nonresidential construction. The results are increased by 5 percent to account for construction projects not reported by F.W. Dodge. This adjustment results from a comparison study of Dodge reports with state and local agency reports for a sample of projects for which contracts were awarded or force account work started. All data are further adjusted by benchmarking the tabulated estimates to annual construction expenditures data collected in the Census Bureau's Annual Survey of Government Finances.

Federal

Beginning with data for January 2002, estimates for this series are based upon a monthly sample survey of projects. The information for creating the sampling frame is obtained from the same F.W. Dodge data used for private nonresidential construction (see above).

The projects are stratified by type of construction and value according to the information from Dodge. Eighty-four strata are created and a sampling rate is assigned to each stratum. Of the 84 strata, 25 are certainty strata. Within each of the remaining 59 non-certainty strata, a systematic sample of projects is selected each month continuing from the sample selected from the previous month. Once a project is selected it remains in the survey until completion of the project, and monthly construction progress reports are requested from the appropriate agency in charge of the project or its designated agent, such as the builder or architect responsible for the project. The average number of projects in the survey at any one time is about 700. These include newly selected projects, as well as projects carried over from previous months.

Tabulation of data is the same as for private nonresidential and state and local construction. The total monthly federal estimates are further adjusted by benchmarking the tabulated estimates to monthly data, which, with few exceptions, are supplied to the U. S. Census Bureau by each federal agency involved in construction activities. Information is obtained from federal budget documents for a small number of agencies where information cannot be directly supplied. These budget totals are prorated over the fiscal year to derive monthly estimates.

Monthly Progress Patterns for Private New Single Family Residential Buildings by Month of Start

(Percent of the value of units started monthly)

Month of activity[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1st	15.8	15.8	15.8	15.8	15.9	16.9	16.9	16.9	16.9	16.9	16.9	15.8
2nd	21.7	23.2	22.5	22.5	22.9	23.8	23.8	23.8	23.8	23.8	21.7	21.7
3rd	21.0	20.1	20.8	20.8	20.8	20.8	20.8	20.8	20.8	18.3	18.3	18.3
4th	16.3	16.0	16.0	16.0	16.0	16.0	16.0	16.0	13.7	13.7	13.7	16.8
5th	10.6	10.3	10.3	10.3	10.3	9.5	9.5	8.8	8.8	8.8	11.7	11.7
6th	6.1	6.1	6.1	6.1	6.1	5.8	5.8	5.1	5.1	7.4	7.6	6.7
7th	3.5	3.5	3.5	3.5	3.5	2.7	2.7	2.7	4.3	4.8	4.3	4.0
8th	2.0	2.0	2.0	2.0	1.5	1.5	1.5	2.5	2.8	3.3	2.8	2.0
9th	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.6	2.0	1.2	1.2	1.2
10th	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
11th	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
12th	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

[1]Month of start is first month of activity.

Sampling Rates for Private Nonresidential Construction Projects, by Type of Construction

Value[1] ($1,000)	Lodging	Office	Commer-cial	Health care	Educa-tional	Religious	Amuse-ment and recrea-tion	Transpor-tation	Power	Manufac-turing	NEC
$10,000 or more……	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
$5,000 to $9,999……	1/4	1/3	1/2	1/4	1/4	1/1	1/2	1/1	1/1	1/1	1/2
$2,000 to $4,999……	1/8	1/6	1/4	1/6	1/6	1/2	1/4	1/1	1/2	1/3	1/4
$750 to $1,999……..	1/8	1/6	1/12	1/8	1/12	1/8	1/8	1/2	1/2	1/3	1/6
$250 to $749……	1/16	1/25	1/25	1/20	1/16	1/25	1/20	1/4	1/4	1/8	1/12
$75 to $249……..	1/40	1/40	1/40	1/35	1/25	1/40	1/40	1/8	1/6	1/25	1/30

[1] Based on the value shown on the Dodge report.

Note: Projects in cells with sampling rates of 1/1 are selected with virtual certainty.

NEC = Public safety, communication, highway and street, sewage and waste disposal, water supply, and conservation and development.

Sampling Rates for State and Local Government Construction Projects, by Type of Construction

	Residenti-al	Office	Health care	Educa-tional	Public Safety	Amuse-ment and recrea-tion	Transpor-tation	Highway and street	Sewage and waste disposal	Water supply	Conserva-tion and develop-ment	NEC
$10,000 or more……	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
$5,000 to $9,999……	1/1	1/2	1/2	1/12	1/2	1/2	1/2	1/12	1/4	1/4	1/1	1/2
$2,000 to $4,999……	1/2	1/4	1/4	1/35	1/4	1/4	1/4	1/35	1/8	1/6	1/1	1/4
$750 to $1,999……..	1/4	1/8	1/6	1/60	1/8	1/8	1/8	1/60	1/16	1/16	1/2	1/6
$250 to $749……..	1/8	1/16	1/12	1/100	1/16	1/16	1/16	1/100	1/25	1/25	1/2	1/25
$75 to $249……..	1/12	1/20	1/20	1/180	1/20	1/20	1/30	1/180	1/60	1/60	1/4	1/60

[1] Based on the value shown on the Dodge report.

Note: Projects in cells with sampling rates of 1/1 are selected with virtual certainty.

NEC = Lodging, commercial, religious, communication, power, and manufacturing.

Sampling Rates for Federal Construction Projects, by Type of Construction

Value[1] ($1,000)	Lodging	Commer-cial	Health care	Educa-tional	Religious	Amuse-ment and recrea-tion	Commu-nication	Power	Highway and street	Sewage and waste disposal	Water supply	Conserva-tion and develop-ment	Manufac-turing	NEC
$10,000 or more……	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
$5,000 to $9,999……	1/1	1/1	1/2	1/2	1/1	1/1	1/2	1/2	1/2	1/1	1/2	1/1	1/1	1/1
$2,000 to $4,999……	1/4	1/2	1/4	1/6	1/2	1/1	1/6	1/2	1/6	1/2	1/6	1/1	1/1	1/2
$750 to $1,999……..	1/4	1/4	1/6	1/8	1/8	1/2	1/8	1/4	1/12	1/4	1/12	1/2	1/2	1/4
$250 to $749……	1/16	1/8	1/12	1/25	1/25	1/4	1/12	1/8	1/25	1/10	1/35	1/2	1/4	1/8
$75 to $249……..	1/40	1/20	1/20	1/40	1/60	1/8	1/30	1/20	1/60	1/20	1/60	1/4	1/8	1/12

[1] Based on the value shown on the Dodge report.

Note: Projects in cells with sampling rates of 1/1 are selected with virtual certainty.

NEC = Residential, office, public safety, transportation.